ATTACHMENT A

AIRBORNE COMMUNICATIONS NODE

TECHNICAL THRESHOLDS AND GOALS

MDA972-98-R-0006

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A1.0 INTRODUCTION

This document presents a system level introduction to the thresholds and goals for the Airborne Communications Node (ACN) system. The information contained in this document should be considered as the minimum capabilities, services, interfaces, performance and operation associated with the ACN, together with the performance goals for the ACN payload. It is not intended to define or specify how the ACN system architecture should be implemented. However, Attachment A contains guidance as to the desired system characteristics for the ACN.

ACN is a complex system of communications subsystems providing relay, gateway, bridging and routing of information to and from the warfighter. The ACN payload should ultimately be compatible with the designated host platform (currently specified as the Global Hawk High Endurance Unmanned Aerial Vehicle (HAE UAV)). Demonstrations on alternate aircraft may be necessary to demonstrate system flexibility, modularity, and adaptability. For example, it is a system goal to host discrete subsets of the goal capability on other, smaller platforms (e.g., UAVs such as Predator and manned aircraft such as helicopters).

The ACN program's primary objective is to develop an affordable communications payload that augments the mobile military communications infrastructure by providing an extensive set of enhanced services. Affordability will be measured in terms of payload flyaway price (PFP), which is defined as the Government cost to procure the payload and integrate it on-board the airborne platform -- it does not include the airframe. For the purposes of this solicitation, the projected PFP should be based upon the procurement of 10 ACN payloads. (This is for comparative purposes only -- it does not imply that the Government is committed to purchase 10 ACN payloads.) The PFP is expected to procure a payload that meets the goal performance capabilities. We want your best ideas that can be accommodated at an affordable price. The Contractor is expected to analyze the feasibility and practicality of achieving all ACN goals. The analyses should quantify trade-offs to the ACN in terms of costs, performance, size, weight and power (SWAP) and should highlight choices that have significant advantages to the Government for future adaptation of the ACN equipment. For the Phase I demonstration of functional capabilities, it is not necessary that the Contractor meet all of the ACN thresholds and goals. The minimum thresholds for the Phase I demonstration are covered in Section A2.6.

The Phase II ACN should provide the services identified in Table A-1. All services in Table A-1 should operate simultaneously. The “Threshold” functionality represents the minimum expected service and the “goal” represents desired ACN capability.

Services	Characteristic/Purpose	Threshold	Goal
Cellular/PCS-Like	Full Duplex Voice / Data to Handheld Terminal	50 Simultaneous Users	200 Simultaneous Users
Paging	Alpha-Numeric Pages	100 K Addresses, 1 Way	500 K Addresses, 2 Way
Internet-Like Data Networking	Interactive Multimedia Access, Bursty Data	Aggregate Throughput of all Req. Services (50% Margin)	Aggregate Throughput of all Goal Services (100% Margin)
Tactical Battlefield Multicast	Addressable Broadcast (Individual/Group) Selected GBS Rebroadcast	64 kbps	1.544 Mbps
High Speed and High Throughput Infrastructure Access	Intra-Theater and Reachback Access Via: Satcom, LOS, & Crosslinks		
SATCOM Air-Ground LOS Link Crosslinks TWR (RAP)	Out of Theater Connectivity from ACN High Capicity Trunk to ACN from Within Theater Extended Internet Service Coverage HDR Trunk for RAP-to-RAP Relay	>= 10 Mbps FDX >= 10 Mbps FDX 2 @ >= 10 Mbps FDX, 300 nm >= 10 Mbps FDX	>= 45 Mbps FDX, Ka Band >= 45 Mbps FDX 3 Links, >= 45 Mbps FDX >= 45 Mbps FDX
Surrogate Satellite	Support for UHF TACSAT Users, DAMA & non-DAMA	<= 10 HDX Channels	<= 20 HDX Channels
Range Extension	Beyond Line-of-Sight Communications		
SINCGARS UHF LOS EPLRS Link 16 TWR (MSE)	VHF Combat Net Radio UHF LOS Voice and Data and Have Quick Position Reporting and Messaging Air and Ground Situational Awareness MSE Node Extension	10 HDX Chs., 2 Full TX ECCM 10 HDX Channels 1 Channel 1 Channel 2 FDX Links @ 1.544 Mbps	20 HDX Chs., 8 Full Tx ECCM 20 HDX Channels 3 Channels 1 Channel 4 FDX @ 1.544 Mbps
Dissimilar Radio Interoperability	Joint Service and Coalition Forces Interoperability	Voice/Voice & Data/Data	Non-Blocking Connectivity

Table A-1: ACN Services

The ACN should have an open, flexible, scalable architecture to adapt to varying user communications requirements. The goals and objectives of such an architecture include the following:

Reprogrammable - The ACN architecture should support the ability to implement and change varying capabilities by initializing different application software modules;

Reconfigurable - The ACN architecture should be able to adapt to changes in user and mission requirements, such as the capability to change the payload configuration during flight (i.e., channel allocations, waveforms, routing tables, etc.) to support force reorganization;

Modular - The ACN architecture should be able to support the ability to change the system’s attributes by physically changing modules (hardware and/or software), such as modules utilizing new technologies;

Scalable - The ACN architecture should be able to support the addition or deletion of system capabilities to accommodate larger or smaller requirements, such as increasing the range or number of channels and installation of selected sets of capabilities on constrained or more capable platforms;

Extendible - The ACN architecture should be able to accommodate the addition of new features, functions and technologies without major redesign or re-engineering.

The ACN architecture should be extendible to support growth and change in both technology and operational requirements.

The ACN should be controlled by the Remoteable ACN Control Element (RACE), which should be able to operate in either stand-alone configuration or in conjunction with the Global Hawk Mission Control Element (MCE). The RACE should support dynamic in-flight control and reconfiguration of the ACN payload.

A1.1 Scope

This document contains ACN technical thresholds and goals. The technical thresholds are those attributes of the ACN necessary to meet minimum program objectives. The ACN goals are desired services. The Phase I design should meet the thresholds outlined in Section A2.6 and the proposed Phase II design should meet all thresholds. How well goal services are met should be a differentiator between proposed designs.

This document specifies an open system concept and architectural framework that follows the guidelines of the Department of Defense (DoD) PMCS entity reference model (ERM) and the emerging JTRS architecture. This document is not intended to define or specify an ACN implementation.

A1.2 References

It is necessary to have a thorough understanding of the Global Hawk platform and systems, as well as the current specifications that apply to the ACN services. The Government has facilitated this by establishing an internet home page < http://www.les.mil/acn > which has a limited amount of reference material and other programmatic information.

The following are available for guidance:

- Airborne Communications Node Handheld System Design Study Team Report, 6 March 1998, < http://www.les.mil/acn >;

- Airborne Communications Node (ACN) Design Development for Antenna/ Electromagnetic Interference (EMI) Mitigation System, < http://www.les.mil/acn >;

- Airborne Communications Node (ACN) Payload Development and Antenna Integration Study Highlights, < http://www.les.mil/acn >;

- Airborne Communications Node (ACN) Multi-Subscriber Equipment (MSE) Trunk Relay Circuit Design and Analysis Report, < http://www.les.mil/acn >;

- Airborne Communications Node (ACN) Evaluation of Candidate Frequency Bands, < http://www.les.mil/acn >;

- SINCGARS Cosite Analysis Using CLIC/CLAC Design, < http://www.les.mil/acn >;

- System Concept for the Communications Controller and Programmable Infrastructure of the Airborne Communications Node, < http://www.les.mil/acn >;

- Architecture and Concept of Operations for a Warfighter's Internet, Volumes I & II, 28 January 1998, < http://www.les.mil/acn >;

- Tactical Common Data Link (TCDL) specifications;

- Accords de Standardization (STANAG) 4175 (North Atlantic Treaty Organization (NATO) Secret): Link 16;

- MIL-STD-6016: Link 16 Message Protocols;

- MIL-SPEC-A3109210: critical item development specification for Enhanced Position Location and Reporting System (PLRS) User Unit (U), December, 1993;

- Joint Tactical Command, Control and Communications Agency (JTC3A) 9001C: Single-Channel Ground and Airborne Radio System (SINCGARS) Waveform;

- Single-Channel Ground and Airborne Radio System (SINCGARS) System Engineering document, June 26, 1997, ITT Corporation # 83214186: SINCGARS Improvement Program (SIP);

- MIL-STD-188-220 Protocol Profile for Task Force XXI;

- MIL-STD-188-182, MIL-STD-188-183 for UHF DAMA;

- Have Quick I/II Prime Item Development specification #SS 103190;

- Product Specification for Radio Set (Line of Sight (LOS)) Army Navy/Ground Radio Communications-226 (AN/GRC-226) (V2), SP-00-1390219;

- Joint Technical Architecture, < http://www-jta.itsi.disa.mil/ >, < http://www.hqda.army.mil/techarch >, < http://infosphere.safb.af.mil/~tnb/ >;

- Programmable Modular Communications System (PMCS), < http://www.dtic.mil/c3i/pmcs/pmcspage.htm >;

- Joint Tactical Radio System (JTRS) Operational Requirements Document (ORD), 11 Feb 98, < http://www.dtic.mil/jcs/j6/jtr11_feb.html >

- Joint Airborne SIGINT Architecture (JASA) Standards Handbook Version 2.0, 3.0 October 1997, < http://www.jswg.org/handbook.html >;

- Defense Information Infrastructure Common Operating Environment (DII COE), as applicable to real time communications systems, <http://spider.osfl.disa.mil/dii/ >;

- Battlefield Information Transmission System (BITS) Far Term Strategy, Sept 97, < http://fotlan5.fotlan.army.mil/BITS/bits.html >

- Extended Littoral Battlefield (ELB) Program, < http://www.onr.navy.mil/02/baa/elbactd/progdesc.htm >;

- Global Mobile (GloMo) Program, < http://glomo.sri.com/ >;

- Small Unit Operations (SUO), < http://web-ext2.darpa.mil/tto/suo.html >;

- Speakeasy Program, < http://www.rl.af.mil:8000/Technology/Demos/SPEAKEASY/ >;

- Ultra Communications Program, < http://www-er.rl.af.mil/UltraComm/ >; and

- US Army Communications-Electronics Command's Digital Integrated Laboratory, < http://www.monmouth.army.mil/cecom/rdec/dil/dil-home.htm >.

A2.0 TECHNICAL THRESHOLDS AND GOALS

This section describes the thresholds and goals for the ACN system. The Contractor is encouraged to be innovative in developing the ACN design to meet all goals. The Government is seeking the most capable system within the affordability goals. Specific affordability goals, which will be based on military utility and affordability, will be established prior to release of the Phase II solicitation. Contractors are expected to do the technical trade-off analyses, and tests or demonstrations when appropriate, to convince the Government that claims of technical feasibility and affordability are realistic. The most capable, affordable system may include Contractor-proposed capabilities beyond the goals listed in this section and/or Contractor-proposed capabilities not requested in this solicitation.

A2.1 ACN Communications Services

As shown in Table A-1, the ACN should provide several simultaneous communications services, which include:

- Cellular/PCS-like
- Paging
- ILDN
- Tactical battlefield multicast
- High speed and high throughput infrastructure access
- Surrogate satellite
- Dissimilar radio interoperability
- Range extension.

Each of these services is described in detail in the following sections.

All communications services should be designed to operate simultaneously worldwide from an altitude of 65,000 ft and support a 100 mile radius coverage area with a goal of a 150 mile radius unless otherwise specified. As applicable, each service should be designed to be secure and support communications-on-the-move. Further, it is a goal that each applicable service comprise some level of LPI/LPD and A/J characteristics and support a means to prevent an enemy for gaining access to a service by confiscating a ground terminal.

Discrete identification of the ACN services in this document does NOT imply that the Government desires a payload that is compartmentalized by service. The Contractor is encouraged to develop innovative solutions that combine the service implementations into a single integrated payload that shares subsystems and/or links in an efficient manner. Further, it is a goal of the Government to allow the dismounted warfighter access to the ACN services via a single, highly flexible, multi-function device.

It is a goal that subscriber ground-based elements associated with ACN communications services be capable of operating at some reduced capability in the absence of the ACN (i.e., system degrades gracefully when ACN leaves the theater). Terrestrial services and/or satellite links may be included as part of the system to provide these graceful degradation characteristics. Graceful degradation considerations should be applied to the following services: cellular/PCS-like, paging, ILDN and tactical battlefield multicast.

The specific thresholds relating to these communications services are summarized in Table A-1. Sections A2.1.1 through A2.1.7 provide design guidelines for each of the services. It is important to note that, unless otherwise stated, each of a particular service's thresholds/goals is independent of the others. As an example, consider a service that has a data rate threshold of 1 kbps with a goal of 1 Mbps and a range threshold of 100 nm with a goal of 300 nm. The 1 Mbps goal does not apply only to the 300 nm goal. In other words, it would be desirable to have the service support 1 Mbps at 100 nm even if it supported on 1 kbps at 300 nm.

A2.1.1 Cellular/PCS-Like

Cellular/PCS-like services refer to connection-oriented services that are normally associated with cellular telephones, the newer PCS systems and the emerging mobile satellite systems (MSS). The term "cellular/PCS-like" is being used to characterize the type of service, and not to imply that an existing PCS or cellular realization will satisfy the DoD ACN needs.

The Cellular/PCS-like service should provide point-to-point connections which can be used (with appropriate subscriber devices) for such functions as voice, facsimile (FAX), low rate video and point-to-point protocol (PPP) dial-in data connections. Although the physical connection may be much like that of a telephone's dedicated circuit, the data itself (even if voice) may be formatted as packets for maximum flexibility in interconnection and routing with other systems. Paging and conference calling are desirable cellular/PCS-like features.

The ACN cellular/PCS-like service should support the switching of both voice and data connections to other ACN assets and associated communication systems**.** This switching may be to another similar PCS system or to dissimilar voice and data functions associated with the ACN (i.e., voice to other PBX type systems through ACN, Internet Protocol (IP) data to routing function).

The implementation of this service should be frequency agile to allow worldwide operation. Selection of specific frequency bands of operation is left to the Contractor, however, the Joint Spectrum Center (JSC) has conducted a study of candidate frequency bands and the results are posted on the web page for the Contractor to review. The Contractor is not bound by the JSC study results.

The cellular/PCS-like service thresholds and goals are as follows:

	Threshold	Goal
Voice Quality	Toll	-----
Streaming Data Rate	2.4 kbps	64 kbps
Simultaneous Users	50	200
Frequency Band	Freq. Agile	-----

A2.1.2 Paging

A paging service can be used in a variety of ways. Individuals (or multicast groups) can be paged in order to elicit a communication response or to convey short messages. This service can also be used for rapid dissemination of battlefield warnings (e.g., a chemical, biological warfare attack). As a goal, users should be able to generate a page or acknowledgment via the paging terminal (i.e., two-way paging). At a minimum, users should be able to generate a page or acknowledgment via another ACN service (e.g., cellular/PCS-like).

An addressing mechanism should be employed so that handheld paging and cellular/PCS-like units should have the means to filter the paging stream in order to determine which data to process further and how to save battery power. The address scheme should include unicast, multicast and broadcast capability. The paging thresholds and goals are summarized as follows:

	Threshold	Goal
Addresses	100,000	500,000
Addressability	Unicast, Multicast, Broadcast	-----
Data Field	Alpha-Numeric	-----
Acknowledgments/ Generation	Via Another ACN Service (e.g., cellular/PCS-like)	Two-Way Paging

The paging system should be consistent with current commercial alpha-numeric paging standards and technology. The page should be receivable by the cellular/PCS-like terminal and a device similar to a commercial pager.

A2.1.3 Internet-Like Data Networking (ILDN)

ILDN communication services are needed to support a wide variety of applications that are based on the "internet paradigm" (e.g., connectionless message transactions such as electronic mail). Many of these transactions are asymmetric, involving short bursts of uplink user activity followed by either lengthy downlink data transfers from servers or short acknowledgments.

As part of the ILDN services, the ACN should include a routing function that should enable an ACN to function as a network node in a larger theater-wide network structure and provide a connection to other networks, such as the Army's Tactical Internet. This capability should provide data communications support for COTS hosts/workstations using the DoD standard suite of TCP/IP protocols. Migration to IP Version 6 is a goal.

The ILDN is a service that should be accessed over the ACN data communications assets (e.g., PCS data services, programmable radio links, high bandwidth infrastructure, etc.). The ILDN should be sized to support the aggregate data throughput resulting from all ACN data services (e.g., PCS user data links, crosslinks, programmable radio links, etc.) operating at their minimum and goal capacity. A 50% performance margin should be accommodated as a minimum with 100% as a goal.

The ILDN thresholds and goals are summarized as follows:

	Threshold	Goal
Capacity	Aggregate of ACN Data Services (Threshold + 50 %)	Aggregate of ACN Data Services (Goal + 100 %)

A2.1.4 Tactical Battlefield Multicast

ACN should support a tactical battlefield multicast service for forces on the move. The threshold capacity for this service is 64 kbps and the goal is 1.544 Mbps. This broadcast is intended to support a subset of the 23 Mbps streams carried by the global broadcast service (GBS). This service could also be used to disseminate situation awareness data generated in-theater.

The ACN should support injection of broadcast information from the RACE and the high speed and high throughput infrastructure access service. It is a goal to have ACN receive the GBS downlink onboard and provide selected rebroadcast over the tactical battlefield multicast service. A broadcast address mechanism should be employed to select receiver groups. The address scheme should allow unicast, multicast and broadcast capability. A provision should be included in order to vary the instantaneous data rate of the downlink broadcast from 64 Kbps to 1.544 Mbps in order to accommodate known channel conditions of users or groups of users.

The tactical battlefield multicast thresholds and goals are summarized as follows:

	Threshold	Goal
Broadcast Data Rate	64 kbps	1.544 Mbps
Addressability	Unicast, Multicast & Broadcast	-----
Injection	Via RACE & High Speed & High Throughput Infrastructure Access	Onboard GBS Reception & Selected Rebroadcast

A2.1.5 High Speed and High Throughput Infrastructure Access

In addition to augmenting the mobile infrastructure within the field-of-view, ACN should provide high speed and high throughput infrastructure access to both mobile and fixed communications infrastructures as depicted in Figure A-1. Sections A2.1.5.1 - A2.1.5.3 discuss the three links that are desired to support this service.

A goal for the ACN system is to function either as a standalone communications platform or as part of a multiple platform airborne network. When more than one ACN platform is deployed to support the same theater of operations, the platforms should be expected to transfer data between each other through the use of crosslinks. This capability should also provide additional range extension capabilities. In addition, the ACN should provide high capacity links to out-of-theater assets via SATCOM and in-theater assets via LOS air-to-ground links. These links should be capable of carrying multiplexed voice and data to/from all other ACN assets.

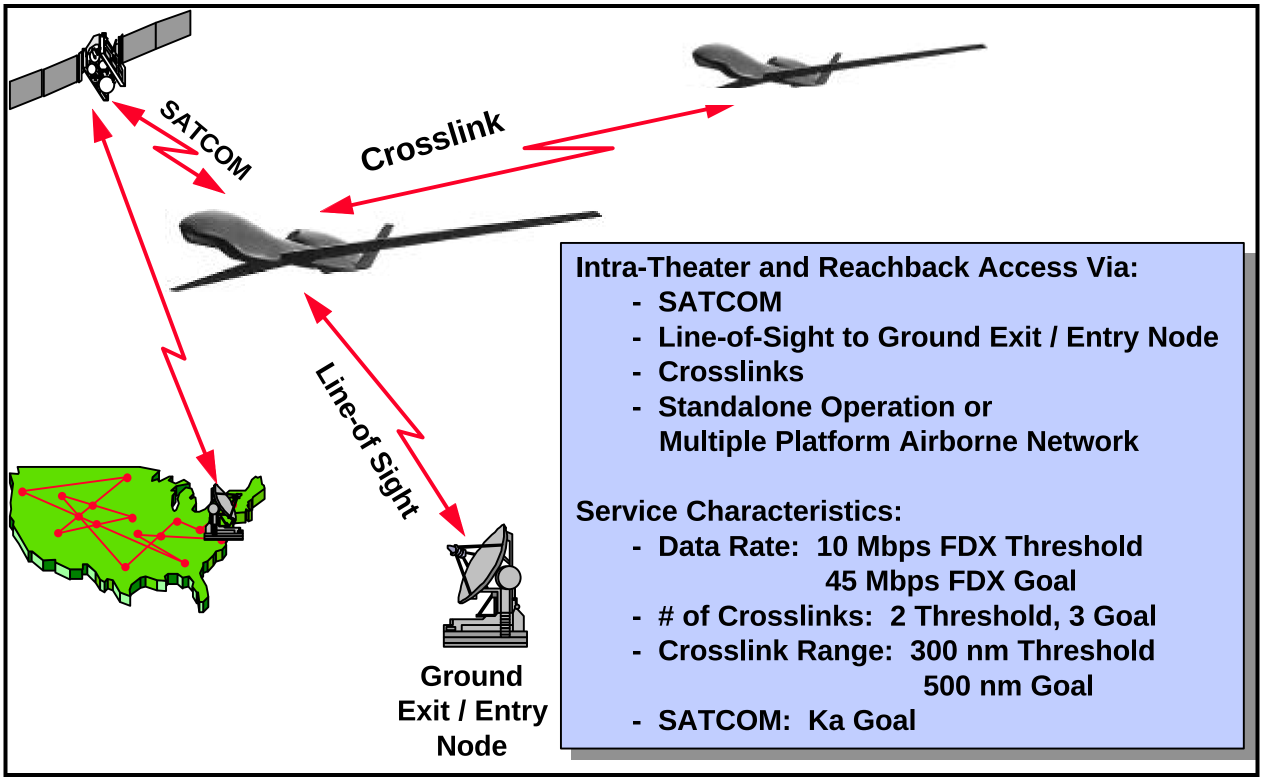

Figure A-1: High Speed and High Throughput Infrastructure Access

A2.1.5.1 Satellite Communications (SATCOM)

The ACN payload should have a high data rate SATCOM link to support out of theater connectivity. To maintain compliance with the evolving DoD military satellite communications (MILSATCOM) architecture, it is a goal to utilize Ka-band to support the SATCOM link. The SATCOM thresholds and goals are summarized as follows:

	Threshold	Goal
Frequency Band	-------	Ka-band
Data Rate (FDX)	10 Mbps	45 Mbps

The existing Global Hawk Ku-band SATCOM suite should remain to support the Global Hawk flight control command link. It is designed to support a return data rate of 47.85 Mbps to a mission control ground station with an 11.3 meter antenna and a forward data rate of 200 kbps. The contractor may investigate modification to the existing Ku-band hardware suite to allow it to support the desired data link AND the command link, but the Contractor's design should not affect the existing Ku-band control link from the MCE to the Global Hawk.

A2.1.5.2 Air-to-Ground LOS Link

The ACN should support a high capacity air-to-ground LOS link with a ground exit/entry node as part of the high speed and high throughput infrastructure access service. The air-to-ground LOS thresholds and goals are summarized as follows:

	Threshold	Goal
Data Rate (FDX)	10 Mbps	45 Mbps

The air-to-ground LOS link should support provisions for a payload command and control link from the RACE to the ACN payload since the RACE should act as a ground exit/entry node and serve as an injection point for voice and data as well as provide command and control for the ACN payload. However, not all ground exit/entry nodes will perform the functions of the RACE.

A secure Common Data Link (CDL) directly between the aircraft and the MCE and other suitably equipped ground terminals is currently installed on the Global Hawk. As currently configured, the CDL provides a 200 Kbps forward link command channel spread over a 97 megahertz (MHz) bandwidth and up to a 274 Mbps return link for sensor data at X-band. The Contractor's design should not affect the existing CDL control link from the MCE to the Global Hawk.

The Contractor is encouraged to consider the ongoing TCDL program for establishing this link.

A2.1.5.3 Crosslinks

A crosslink subsystem should be included on the ACN. Both high data rate and low data rate crosslinks are of interest to provide a backbone for mobile routing and to support hand-off as one ACN leaves a theater and another enters. The crosslink thresholds and goals are summarized as follows:

	Threshold	Goal
Number of Crosslinks	2	3
Data Rate	10 Mbps	45 Mbps
Range	300 nm*	500 nm**

* One aircraft at 65,000 ft and the other no lower than 40,000 ft
** Both Aircraft at 65,000 ft

The Contractor is encouraged to consider the ongoing TCDL and Airborne Imagery Transmission (ABIT) programs as the basis for the crosslink subsystem. The Contractor is also encouraged to study the feasibility of crosslinks with commercial broadband LEO satellites.

A2.1.6 Surrogate Satellite

This service augments available TACSAT services for users that do not have SATCOM access because they have small terminals, need to communicate on-the-move or the SATCOM channels are overloaded.

The surrogate satellite thresholds and goals are summarized as follows:

	Threshold	Goal
Number of Channels (HDX)	10	20

The ACN UHF surrogate satellite capability should support both DAMA and non-DAMA terminals. Each UHF channel should be independently configurable (i.e., programmable) as either a TACSAT or LOS channel.

The Contractor should investigate and report on the feasibility of providing other surrogate satellite support for other MILSATCOM assets such as the Defense Satellite Communications System (DSCS) and Milstar.

A2.1.7 Dissimilar Radio Interoperability and Range Extension

Dissimilar radio interoperability provides radio interoperability between existing legacy radios and networks, as well as the terminals associated with the new services (e.g., cellular/PCS-like and ILDN). Range extension permits communications on-the-move and across diverse terrain. Table A-2 provides a compendium of the goal ACN payload interconnectivity.

The ACN should provide a gateway functionality that supports information flow between two dissimilar radios (i.e., different waveforms, cryptographic configurations, TRANSEC) and/or signaling formats. This function can vary from RF, IF, or baseband switching, to digital message reformatting needed to accommodate differing transmission protocols and standards (including encryption and decryption). The gateway function should support both data and voice networks. The ACN should perform waveform and message translation between U.S. systems. Future ACN capability growth may incorporate gateway services between U.S. and allied systems.

The ACN should support switching of voice services between all transmit and receive entities as appropriate and practical. The switching and translation of voice services may require implementing multiple encoding/decoding (CODEC) algorithms on-board the ACN. The minimum threshold capability is voice interoperability between VHF and UHF systems. The goal is to support voice service interoperability between all applicable ACN circuits.

Link / Data Type		TWR/ MSE	PCS	SINC GARS	HQ	UHF SAT	EPLRS	Link 16	Paging	ILDN	TBM	LOS	SAT COM	Cross-Links	TWR/ RAP
TWR/MSE		●										▲	▲	▲	▲
PCS	Voice/Data		X	X	X	X	X	X	X	X					
SINCGARS	Voice/Data		X	X	X	X	X	X	X	X					
HQ	Voice		X	X	X	X		X		X		LOS	SAT	Cross Links	TWR
UHF SAT	Voice/Data		X	X	X	X	X	X	X	X					
EPLRS	Data		X	X		X	X	X	X	X					
Link 16	Voice/Data		X	X	X	X	X	X	X	X					
Paging	Data		X	X		X	X	X	X	X					
ILDN	Voice/Data		X	X	X	X	X	X	X	X					
TBM											○	▼	▼	▼	▼
LOS		◄			LOS						►	✓	✓	✓	✓
SATCOM		◄			SAT						►	✓	✓	✓	✓
Cross Links		◄			Cross Links						►	✓	✓	✓	✓
TWR / RAP		◄			TWR						►	✓	✓	✓	✓

X	Info Exchange / Range Extension
✓	Transport / Interconnectivity
●	Relay Only
○	Multicast

Table A-2: ACN Interconnectivity

The ACN should include a routing function that will enable an ACN to appear as an internetwork node in a larger theater-wide internetwork structure. This capability should provide data communications support for COTS hosts/workstations using the DoD standard suite of TCP/IP protocols. Migration to IP V6 is a goal.

Sections A2.1.7.1 - A2.1.7.6 provide the design guidelines for the legacy waveforms that support the dissimilar radio interoperability and range extension services.

A2.1.7.1 Single-Channel Ground and Airborne Radio System (SINCGARS) (30–88 MHz)

A SINCGARS and SINCGARS SIP capability should be integrated into the ACN payload. The SINCGARS waveform is specified in JTC3A 9001C (Secret). Waveform data rates for Electronic Counter-Counter Measures (ECCM) are 20 Kbps bursts (16 Kbps throughput).

The SIP waveform should comply with SINCGARS System Engineering Document, June 26, 1997, ITT Corporation # 83214186: SINCGARS SIP.

The SINCGARS thresholds and goals are summarized as follows:

	Threshold	Goal
Number of Channels	10 HDX, 2 Full Tx ECCM	20 HDX, 8 Full Tx ECCM

A2.1.7.2   UHF (225-400 MHz)

ACN should provide UHF LOS and surrogate satellite channels. The UHF thresholds and goals are summarized as follows:

	Threshold	Goal
Number of Channels (HDX)	10	20

Each UHF channel should be independently configurable (i.e., programmable) as either a TACSAT or LOS channel. Specific guidelines for the UHF channels are provided in the next two subsections.

A2.1.7.2.1 UHF LOS (225-400 MHz)

ACN should support both 25 kHz UHF LOS and Have Quick LOS channels. The Have Quick implementation should be guided by the following:

- Have Quick I: The ACN should comply with Have Quick I waveform specifications, documented in Prime Item Development Specification #SS 103190, Have Quick IIA, except as noted below:

  – Net Structure - ACN should employ only A-nets and T-nets for Have Quick I operation.

  – The implementation does not require that one RF channel support the frequency hopping mode simultaneously with the guard channel mode of commonly fielded Have Quick implementations. The ACN should provide the guard channel capability as a user selectable feature at the expense of one ACN RF channel.

- Have Quick II: The ACN should comply with Have Quick II specifications, documented in Prime Item Development Specification #SS 103190, Have Quick IIA, except as noted below:

  – The ACN should provide an indication of an invalid or missing word-of-day and/or missing time-of-day to the RACE.

A2.1.7.2.2 UHF SATCOM

ACN should provide UHF surrogate satellite capability for DAMA and non-DAMA terminals as defined in Section A2.1.6. In addition, the ACN payload should be capable of serving as a gateway between SATCOM users (both non-DAMA and 5/25 kHz DAMA terminals) and other ACN service users.

A2.1.7.3 Enhanced Position Location and Reporting System (EPLRS) (420-450 MHz)

An EPLRS relay/bridging capability should be integrated into the ACN payload. The ACN EPLRS capability should comply with the waveform requirements of current EPLRS and EPLRS Very High-Speed Integrated Circuit (VHSIC) (per Military Specification A3109210: Critical Item Development Specification for Enhanced PLRS User Unit (U), December 1993), as amended per Addendum Critical Item Development Specification for the VHSIC Enhanced Position Locating and Reporting System (PLRS) User Unit (EPUU), June 22, 1993, and Addendum Computer Program Firmware Development Specification for the VHSIC EPUU System Management Plan (SMP), July 28, 1993. The EPLRS functionality should support PLRS compatible modes.

The EPLRS thresholds and goals are summarized as follows:

	Threshold	Goal
Number of Channels (FDX)	1	3

A2.1.7.4 Link 16 (960-1215 MHz)

A Link 16 relay/bridging capability should be integrated into the ACN payload. The reference for the Link 16 waveform is STANAG 4175 (NATO Secret). The reference for the Link 16 message set, data elements and message protocols is MIL-STD-6016. Data rates are 32-bit bursts at 5 Mbps, conveying 5 information bits per burst. The frequency range is 960-1,215 MHz (frequency hopping) with an instantaneous bandwidth of 5 MHz. The message format is Tactical Digital Information Link-J (TADIL-J).

The Link 16 thresholds and goals are summarized as follows:

	Threshold	Goal
Number of Channels (FDX)	1	-----

A2.1.7.5 Tactical Wideband Relay

The ACN should support two tactical wideband relay modes: one at 1.544 Mbps for low rate transfers and one at 10-45 Mbps for high rate transfers. The primary purpose of the low rate transfer mode is to support the MSE node extension and it should be interoperable with the AN/GRC-226 and it's replacement, the High Capacity Line-of-Sight (HCLOS) radio. The primary purpose of the high rate transfer mode is to support the Army's Radio Access Point (RAP)-to-RAP relay.

The tactical wideband relay thresholds and goals are summarized as follows:

	Threshold	Goal
Data Rate (MSE)	1.544	-----
Data Rate (RAP)	10 Mbps	45 Mbps
Number of Channels (FDX)	2 MSE, 1 RAP	4 MSE, 2 RAP

Although the primary function of the low rate mode is MSE node extension, the Contractor should investigate and report on the feasibility of utilizing the ACN as an entry node into MSE via this link. This would entail bridging other ACN services (e.g., cellular/PCS-like handset, SINCGARS, etc.) into MSE. The Contractor should also investigate and report on the feasibility of using this capability for non-MSE wideband relay.

A2.2 Payload Design Elements

The ACN should be developed as an open system with a modular/scalable architecture in conformance with the published DoD PMCS ERM and the emerging JTRS architecture, standards and interfaces. Figure A-2 describes the PMCS ERM. The web page address for PMCS is < http://www.dtic.mil/c3i/pmcs/pmcspage.htm >. The ACN design, to include hardware and software, should also be compliant with the Joint Technical Architecture to the extent possible.

A2.2.1 Open Architecture

An open system approach is an integrated technical and business strategy that defines key interfaces for a system (or piece of equipment) being developed. Interfaces generally are best defined by formal consensus (adopted by recognized industry standards bodies, industry forums,) specifications and standards. However, commonly accepted (de facto) specifications and standards (both company proprietary and non-proprietary) are also acceptable if they facilitate utilization of multiple suppliers. The use of de facto specifications and standards takes advantage of the fact that firms, particularly those in the commercial arena, frequently develop hardware, software and systems standards for the design and fabrication of computing, telecommunications, display, sensing, and signal processing systems. Whether interfaces are described by consensus or de facto standards, the benefits only accrue if products from multiple sources are economically possible.

A system architecture identifies components, relationships between components, and rules for the architecture's composition. An effective open system architecture will rely on scalability or physical modularity and functional partitioning of both hardware and software.

Scalability or physical modularity and functional partitioning should be aligned to facilitate the replacement of specific subsystems and components without impacting others. The subsystems and components described by the system design should be consistent with the system repairable level. If the hardware and software is effectively partitioned, processing hardware can be replaced with new technology without modifying application software. Additionally, application software can be modified without necessitating hardware changes.

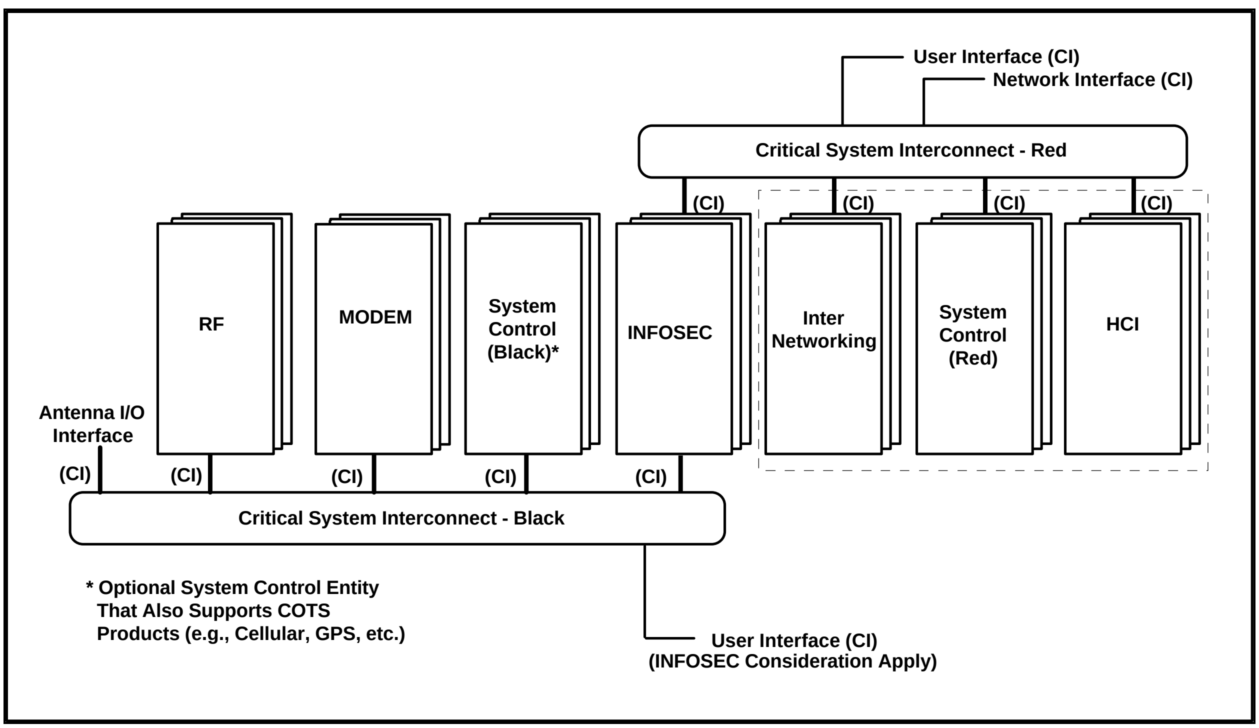

Figure A-2: PMCS Entity Reference Model

A radio applications-processor interface (API) has been developed under the DARPA GloMo program. It is a goal that the Radio API serve as a baseline for evolving to a common radio API. The Contractor is encouraged to utilize this API. Since the Radio API is under development, ACN Contractors can develop extensions for use on ACN and submit them for inclusion in the Radio API.

A2.2.2 Size, Weight and Power

The ACN payload for Phase II should not exceed the size, weight and power (including cooling) (SWAP) available on the target aircraft. The SWAP for the Global Hawk HAE UAV is 130 cubic feet, 900 pounds and 6,000 watts (W) (4,500 direct current (DC) and 1,500 alternating current (AC)). However, to enable dual payloads (i.e., SIGINT and ACN) to coexist (not necessarily operate concurrently) on a Global Hawk the SWAP goals for ACN have been set at: 100 cubic feet, 450 pounds and 5, 000 watts. Support of the goal SWAP and modularity characteristics facilitates payload integration on platforms that do not have the capacity of the Global Hawk HAE UAV (e.g., Predator or a helicopter).

A2.2.3 Security

The ACN should provide support to warfighters at all levels of security (e.g., unclassified through TS/SCI) including NATO and coalition forces and operations other than war (OOTW) and be interoperable with legacy systems. Issues such as multi-system interoperability, legacy system compatibility and interoperability, extensibility, multi-channel and multi-level secure operation, as well as rapid tailoring/reconfiguration are critical.

Data security internal to the ACN at levels from unclassified through TS/SCI should be accommodated. The ACN should support decryption and re-cryption within the airborne payload (at the same security level) in support of the identified relay and gateway capabilities. Simultaneous routing/processing of the various communications paths at multiple levels of security should be accommodated within the ACN payload. This includes both voice and data support.

Multi-level security (MLS) is a goal. However, simultaneous, multiple levels of security can be supported by employing multiple levels of encryption at the user level. This means that the ACN payload should have the capability to route voice and data traffic through the system infrastructure without decryption except at a system high level.

A2.2.4 ACN Platform Integration

The ACN payload should be accommodated on the Global Hawk by removing the existing electro-optic/infrared (EO/IR) and moving target indicator/synthetic aperture radar (MTI/SAR) sensor payloads. However, the existing Global Hawk integrated communications suite and survivability suite equipment and functionality will remain.

The ACN payload should be designed to minimize impact on the Global Hawk altitude, mission duration and coverage area and should operate simultaneously with the communications subsystems currently onboard the Global Hawk. The ACN Group A components (i.e., any permanently installed equipment such as antennas, cables, mounting hardware) should be designed to minimize impact to the airframe.

The helicopter-based airborne ACN payload, which may consist of a subset of a full capability payload, should have an installation/removal time (except for the antennas, cabling and connectors for the antennas, and prime power) not to exceed two (2) hours. Any external antennas on the helicopter variants should either be permanently affixed or also be removable within the same two (2) hour period. The helicopter ACN payload implementation should be a demonstration of the modularity and scalability of the ACN design.

A2.3 Payload Control Concept

The ACN payload should be controlled by the RACE, which should be capable of operating in either stand-alone configuration or in conjunction with the Global Hawk MCE. When in stand-alone configuration, no connection with a ground infrastructure should be required. The RACE is intended to allow local command and control of the ACN payload by tactical units. The ACN control concept is depicted in Figure A-3. It is a goal of the ACN program to have the payload exercise autonomous control to the extent feasible.

The RACE is responsible for the dynamic payload control and status monitoring. It is anticipated that the existing Global Hawk 200 kbps command link should be sufficient to support both the Global Hawk platform command and control and the ACN payload monitoring and control functions. The contractor is encouraged to investigate the feasibility of using these same links for the RACE and identify any issues associated with sharing the links with the MCE. When in standalone mode, the RACE should have the capability to communicate with the ACN via the LOS Air-to-Ground link for voice, data and monitoring and control.

When operating in conjunction with the MCE, the MCE communications links should be used for payload monitoring and control. The Contractor should identify any necessary modifications to the Global Hawk MCE and the Ku and CDL equipment on the aircraft.

The RACE should also serve as an injection and control point (e.g., multicast address assignment) for the tactical battlefield multicast and paging services and as a ground exit/entry node for the high speed and high throughput infrastructure access service. As such, the RACE should allow for connectivity to high volume information sources. The Contractor is encouraged to investigate the full duplex, symmetrical TCDL as a means to provide a high data rate LOS link between the ACN and the RACE.

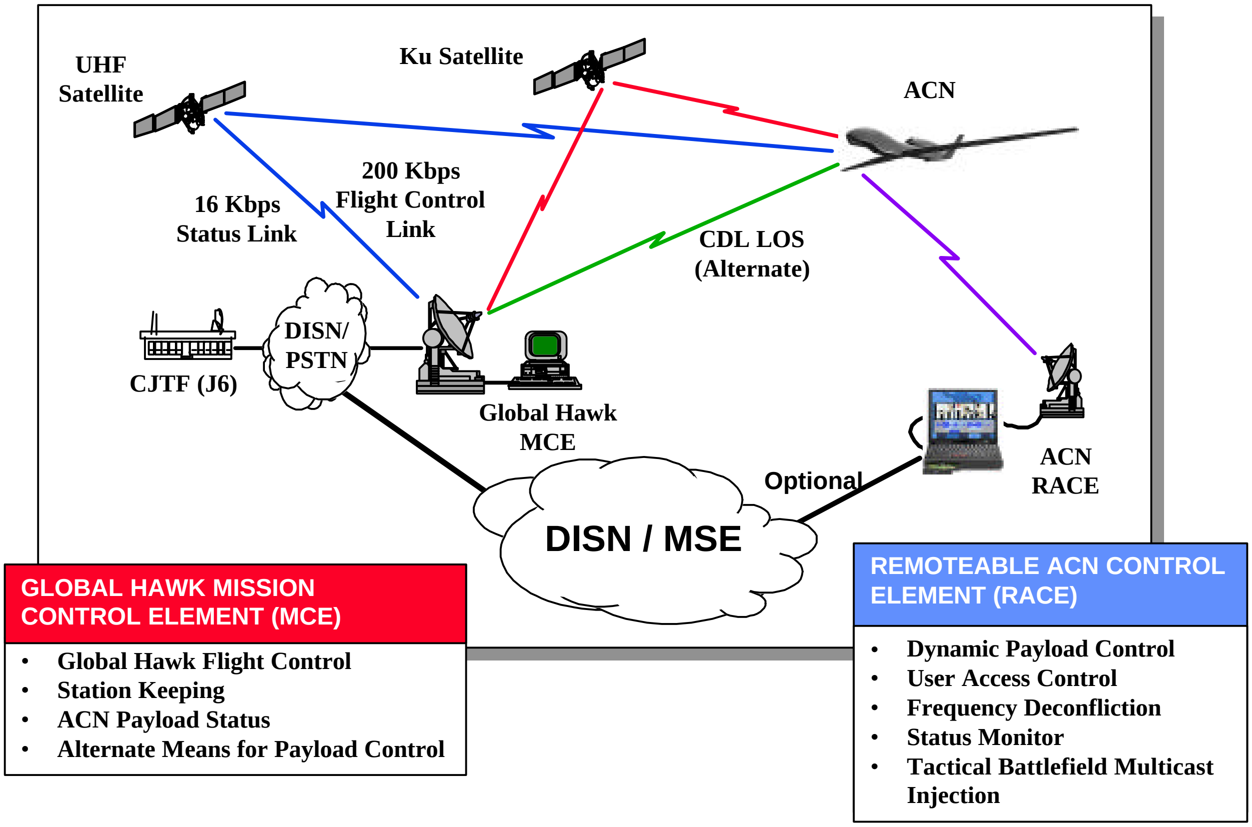

Figure A-3: ACN Control Concept

A2.4 Maintenance, Repair and Logistic Support

The Contractor should propose repair and maintenance concepts in his proposal. The Contractor should identify the lowest level of repair, replacement parts, operator and maintenance personnel tasks, anticipated test equipment, special tools and overall logistic support concept.

A2.5 Risk Mitigation

The DARPA ACN program is a technology demonstration effort. Some of the proposed capabilities will likely be provided by new, state-of-the-art technologies. New, unproven technologies introduce an inherent risk factor. The Contractor should address risk mitigation in the proposal and should provide a risk mitigation plan as part of the Phase I program.

Risk management should be an integral part of any ACN program. The ACN risk management process should include the following steps:

- Risk Identification - determining what the risk areas are;
- Risk Assessment - quantifying and ranking the risk levels;
- Risk Mitigation Plans - determining what steps should be taken to reduce the risks to acceptable levels for each program stage; and
- Risk Management - integrating these steps and providing the monitoring and execution of the plans to reduce risk.

This should be an iterative approach to achieve the following objectives:

- Achieve pre-planned levels of risk reduction at each program milestone;
- Periodically reassess program risk to ensure the mitigation of any new risk issues;
- Ensure the allocation or program assets for the priority risk issues;
- Enable the execution of expeditious recovery plans.

A2.6 Phase I Demonstration Thresholds

Phase I is expected to be completed within 17 months of award. During this phase, the objective is to complete a design study for the payload and build and flight-test a proof-of-concept payload. The payload flight tests will demonstrate the full complement of ACN capabilities and performance characteristics to the extent possible prior to Phase II activities. The focus of the Phase I demonstration is to demonstrate the utility of associated system capabilities and to aid in the evaluation of associated Phase II issues. Phase I equipment is anticipated to be mostly commercial items with modifications to change operating frequency (if required) or to add security/robustness features. In addition to the ACN Phase I performance demonstration, it is the intent of the government to include demonstrations (simultaneous if possible) of competing Contractors' hardware in one or more major U.S. military training exercises.

The Phase I flight demonstration should demonstrate, at a minimum, the following (all other thresholds and goals as defined in this document are to be considered goals for the Phase I demonstration, however, contractors are encouraged to demonstrate more than the minimum specified here):

<u>Voice Circuits:</u>

VHF: 4 SINCGARS voice circuits (SIP is goal). TRANSEC with range extension and bridging between SINCGARS nets. COMSEC within the same net.

UHF: 4 circuits of any combination of SATCOM and Have Quick. DAMA is a goal. COMSEC bridging between similar waveforms and nets. Demonstrate range extension and bridging with TRANSEC.

Data Circuits:

An Internet-like capability should be demonstrated with a minimum single user data rate of 2400 bps aggregate. The Contractor should propose and demonstrate a solution to provide this capability.

The Contractor should demonstrate a high data rate (aggregate 1.544 Mbps or greater), secure data circuit. The specifics are left to the Contractor.

Control Circuits:

The Contractor should demonstrate a ground/air/ground control link for the ACN payload. The Contractor should propose and demo a solution to this. During lab demo, the payload controller should detect built-in test (BIT) alarms, take offending unit off-line and configure a spare to take it's place. During flight, the payload controller should provide status, restart system and provide system states of each modular unit.

The voice and data circuits should be demonstrated in simultaneous operation and should be software reconfigurable.

It is the Government's desire that Phase I serve as a foundation for Phase II. Specifically, Phase I should not be viewed as a separate entity and Phase II should not be viewed as a "new start". Phase II should leverage, to the maximum extent possible, the Phase I design and development. This does not preclude the Contractor from proposing modifications to the Phase I approach and design in the Phase II proposal.